Telephone interview with Dr. Gerald Moss, participant in the Navy blood program during the Vietnam War. Conducted by Jan K. Herman, Historian of the Navy Medical Department, 5 November 2004.

Where are you from originally?
I was born in Cleveland.

Where did you go to college?
Ohio State.

When did you decide you wanted to be a physician?
In high school.

Where did you go to medical school?
Also Ohio State.

Did you go into the Navy right after medical school?
Those were the days of the Berry Plan. Some friends and I all joined the Navy Reserve.

So you were on the Berry Plan. That meant you could do your residency and then go on active duty.
That's correct.

Had you begun leaning toward a particular area of interest in medical school?
I became interested in surgery very early on in medical school.

When did you go on active duty?
July of '65.

Was there any orientation into Navy life?
It was complicated. That was a couple of months after the Vietnam War began in earnest after the U.S. intervened with the Marines landing in Danang in March of '65. My surgical residency was at the Massachusetts General Hospital. I had spent almost a year abroad in Manchester, England working on liver transplantation. It was very, very early in that story. We were working on cryopreservation of the liver using glycerol. The experiment was a catastrophic failure but it was a very interesting experience. One of my mentors at the Mass General at that time was working under a Navy contract freezing red blood cells. His name was Charles Huggins. He was working with Bob Valeri, who was then at the Chelsea Naval Hospital.

So because of your work with glycerol, you saw some future in the frozen blood work?
Well, it didn't quite work out that way. I went to BUPERS in my senior year and talked to them about what my Navy career might be like. One of the officers suggested that since I was from the Midwest, I could be assigned to Great Lakes. I was interested in teaching as well. I thought that Great Lakes would be wonderful and that's what I anticipated would happen.

When my orders came early in May of '65, my wife called me and said, "We got the orders."

I said, "Where are we going?"

She said, "Saratoga."

"What do you mean Saratoga? There's no Navy presence in Saratoga. Read me my orders."

"On or about July 1 you will report to the USS *Saratoga*."

Well, that's the Navy.

That's the Navy, right. Then I got a phone call from Charlie Huggins who said, "I understand you're going aboard a carrier." You have to understand, for surgeons, especially just newly minted surgeons, not to be in the operating room on a regular basis is very painful. You had just acquired these skills. He said, "Are you interested in some sort of more intense surgical experience with some research?"

I said, "Of course."

He said, "Let me make a few phone calls." He called me back within the hour and said, "I've got a job for you. It's exactly what you want."

I said, "Great. Where is it?"

He said, "Vietnam."

It was one of those interesting pivotal moments in life. So I said, "Let me think about it." After talking with my wife, I decided to accept it. That began a very fascinating part of my life. I finished my residency and hooked up with Bob Valeri, who was across town at Chelsea Naval Hospital. I took a crash course on red cell physiology and cryopreservation.

The Navy was interested in simplifying blood transfusions for the Marines by limiting the number of blood groups--mostly O negative, and using freezing as a way to stabilize the blood supply. You could store red cells literally forever at minus 80 with glycerol. The Mass General and Chelsea were freezing large numbers of O negative red cells.

I then went out to Camp Pendleton to survivor school.

Was this the Field Medical Service School?

Yes. That sounds like what it might have been. It was essentially for preparing physicians for the realities of combat--throwing grenades, firing .45s, crawling under wire with live fire going over your head. I'd never held a gun in my hand but it turned out to be pretty useful as events played out.

It must have been a sobering experience.

It was a completely unexpected experience, once in a lifetime, quite obviously.

While all this was going on, had you already been the mission of doing the blood research?

Yes. I was to be a general surgeon and officer in charge of the frozen blood program for Marines in Vietnam.

Which was going to be at NSA?

That's correct.

So you knew all this ahead of time.

Yes. I spent time with Bob Valeri and Charlie Huggins thinking about what the clinical trials would look like as we understood clinical trials back in those days. We had spent time on the science side of it talking about exactly how the study would be done.

Did you ship out for Vietnam right after your training at Camp Pendleton?

Yes. But in the meantime, the VC blew up NSA. It was in shambles. I was diverted to Saigon.

Do you remember what it was like arriving in Vietnam?

I do. As a matter of fact, although I don't agree with Oliver Stone, his portrayal of the troops getting off the plane ["Platoon"] is very accurate. We flew over in civilian contract planes. The door of the plane opened and we walked out from civilian life into a war zone. There was a blast of heat and a chaotic environment with lots of stuff going on--people running around, everybody in uniform. It was hotter than anything I had ever experienced because I got there in August.

Where did you go after that?

I have a very vivid memory of what happened. We had an orientation with Gen. [William] Westmoreland shortly after we landed. He looked like a Hollywood character. He was a tall and very handsome guy with salt and pepper hair, and had a presence about him. He spoke to us with tremendous confidence about the mission of the war. I was very dazzled by him.

I was then assigned to an apartment house. My roommate was a Navy psychiatrist and the only one in the country at that time. His name was Richard Gettman.

It was about a block or two from the apartment to the hospital. We had two Chinese maids who cooked for us and cleaned house. There was an air conditioner in the rooms. It was a very pleasant existence inside the apartment, but when you walked out on the street, every alley was filled with people living in little, makeshift containers. These beautiful kids were running around the street washing themselves in little basins beside the street and holding their hands out for whatever they could get.

When was this?

December of '65.

The hospital you are referring to. . . Was that the Station Hospital in Saigon?

Yes. I was assigned there as a general surgeon. I was to remain there until the frozen blood vans for the lab and the freezers arrived. I remained in Saigon for 3 months with several other general surgeons. We ran a general clinic and did some surgery but it was infrequent. Most of it was related to war wounds--shrapnel or landmines. We put a lot of blood vessels back together again.

So, at least, you were able to capitalize on your training while you were awaiting the blood equipment to arrive.

That's correct, but there wasn't really enough surgery to keep on top of my form. However, it was an interesting experience. I became friendly with the chief telephone operator

there who was a Mandarin Chinese lady. She helped me learn Vietnamese and invited me to her home. I had dinner with her family a few times. At that time, I began concentrating on learning Vietnamese so I could bargain with the local merchants and interact with the community. I got a copy of Bernard Fall's *Street Without Joy* and I tried to learn whatever I could about the country. I recall learning was how rotten the French were. I thought the contrast between the French colonial occupation and what we were doing was a dramatic example of how unique this country is compared to the rest of the world.

The French certainly weren't very good stewards during their colonial occupation, that's for sure.

I heard story after story. It was basically the story of exploitation and preventing a people from developing. I saw us as giving them an opportunity to live a free life. But, of course, it became much more complicated later on, but that's what it looked like to me at that time.

When did the equipment arrive and when did you finally have the opportunity to get started on your mission?

In December I got my orders to go north because the vans had arrived. I flew up the coast to Danang and then began to put together the blood banking equipment. When I arrived, I found this huge complex that had been created for a thousand-bed hospital. I think they called it a station hospital for organizational reasons to keep it out of the Marine supply line, which wasn't very good. It had all sorts of high-tech equipment I was used to back in Boston. I thought it was quite a logistic tour de force.

You actually witnessed the construction or as it pretty much finished by then?

It was in the process of being constructed by the Seabees and by Raymond, Morrison, Knudson. RMK was the big contractor for the military. And they used to contract out a lot of the work to Vietnamese locals, half of whom were probably VC.

So this is what became NSA Danang.

That's right. That's a vivid story for me. Because we had no patients, the Marines would not give us a perimeter, which meant that we were on our own. We were just to the west of Highway 1. To the east of Highway 1 were beaches and a Marine air group and a Marine tank group. We were required to man bunkers at night. So there were 22 corpsmen, and by that time the CO had arrived, CAPT Bruce Canaga.

We were in the bunkers every night for 8 weeks until all the Quonset huts were completed. Every night as the sun went down, all of us hunkered down in the bunkers connected by voice-activated phones. The most beautiful sound in the world was the sound of a Marine tank that would cross the road and sit at the west end of the hospital and aim down into the Danang Valley where the Danang River ran. Flares would go off every night and there would be fire fights as the VC came down the river and tried to engage the Marine air group and the Marine tank group.

The tank gave you a feeling of security.

That would be an understatement. Even though I knew how to fire a gun, I knew I couldn't survive a concerted attack.

You medical people, CAPT Canaga and the corpsmen, were just armed with .45 pistols?

No. We had carbines. We were all armed but not proficient. So it was helmets, flak jackets, and locked and loaded. We had every expectation that we were going to get killed. It was 8 weeks of sheer, sheer terror.

This was about December of '65?

That's correct. It was now the monsoon season. It was cold, rainy, and uncomfortable. Eventually, the hospital was completed. I was working with two corpsmen who were specially trained to work in the blood bank area along with an MSC, LT Jim Bates. I think he remained in the Navy and had a career in transfusion medicine.

The blood then arrived from Boston packed in dry ice. Out came these units of frozen red cells, which we transferred to the freezers. We had a big generator and a van. We sandbagged the van and the lab.

What kind of building was the lab in?

It was a van. These were two vans that had "Frozen Blood Bank" written on the sides.

Were they like semi truck trailers?

They were like the temporary offices you see beside construction sites. One was essentially a freezer--a minus 80 freezer--and the other was a lab to make blood measurements and do calculations. We didn't have computers at that time. We recorded our data with pencil and paper.

Our freezer capacity was in the hundreds, units-wise. I was responsible for the blood bank as well as the frozen blood program. I was also responsible for transfusion medicine the time I was there.

Who were the donors?

Let me take a moment to describe the procedure. The blood was collected around the U.S. and also through the Red Cross. So its source was both military and civilian. The blood was then further refined so that they were negative for a couple of common antigens--Kell and Duffy. These were cells that were truly universally compatible and wouldn't produce any clinically significant antibodies. It was the ideal universal donor blood. These cells were then immersed in glycerol, frozen, packed in dry ice, and shipped to us in Vietnam.

How were the freezers powered?

They worked off electricity from a gasoline generator. These were standard minus 80 stock freezers used for science. We had a large supply of O Kell-Duffy negative red cells and we just packed them in those freezers.

The idea was to take this frozen blood, thaw it, wash it, and then use it on patients in the hospital to see how it worked. Is that correct?

Yes. This, in essence, was a clinical trial in which there was a waiver of consent. It couldn't have been done any other way because of the magnitude of injuries. The idea was to study patients that had been given these formerly frozen red cells.

What was the process of removing the glycerol at that time?

We used machines that were developed specifically to wash the cells through the process of agglomeration.

So you didn't have the Cohn Fractionator?

No. We did not use the Cohn Fractionator. The cells were placed in very long bags with glucose and were hung up on a machine. The cells all agglomerated--settled to the bottom of the bag. The bag was then manipulated in such a way that you ended up with only the red cells at the bottom. The wash solution was removed from the top. You were then left with about 200 CCs of red cells.

The wash solution was used to eliminate the glycerol. Is that correct?

Yes. You needed to get the glycerol out of the cells. The agglomeration process was one technique. One of the problems we had was the volume of wash solution required to produce glycerol-free red cells. Getting whatever wash solution we needed never posed a logistics problem while I was there and never inhibited our ability to do the study.

I should mention the name of Chuck Brodine who was really the godfather of the study. He took personal interest in ensuring that we got whatever we needed. I have nothing but respect for him. He's a wonderful, warm human being. From January to when I left in July, we did the study.

How did you interface with the surgery department at the hospital?

I was part of the surgery department.

So you were really on both ends.

Yes. That's one of the things that made the thing work so smoothly. There was never an instant of friction or any sort of turf problems. There were four or five general surgeons and anesthesiologists. Everybody was interested in the project.

And I'll tell you why there was so much enthusiasm. The blood that we were regularly getting through the system, coming through Saigon and then up to Danang, averaged about 18 days since it had been drawn. That only left us a few days before it was outdated. I never saw this data published, but my memory is that the vast amount of the regular blood we received for the Marines ended up being outdated and had to be discarded. Well over half of what we got was not useable. And the reason was that the battles were episodic and unpredictable. So we would outdate large numbers of units. There were times we had a lot of blood but didn't have compatible units. That's why this project seemed so exciting to us. The idea was to determine whether or not the mechanics of this would work because it took about 20 minutes to a half hour to actually thaw the frozen cells in a water bath and then agglomerate the red cells, and get them ready for transfusion. I believe that despite the fact that they were universally compatible, we were still doing cross matches as well.

Just as insurance?

Yes. That's my recollection.

So the study began and we learned very quickly that those Marines who had tremendous injuries required huge amounts of fluid and blood. The typical patient ended up with a number

of units of frozen red cells and a number of units of liquid preserved blood. So most of those patients ended up with combinations. The study was confounded by the fact that military medicine was so good. It was so good that if you didn't have a head injury and you weren't a KIA, the odds were overwhelming that you were going to survive. That made the study a little more complicated. I don't know whether this story has really been told as dramatically as it should. If you compare the quality of medicine between Korea and Vietnam, it's a quantum leap. I think it has to do with the fact that everybody there was trained to the teeth before they came. Every time an endotracheal tube was put down, it was done so by a trained anesthesiologist. Every time a head was operated on, it was done by a trained neurosurgeon. Whenever a belly was opened, it was done so by a trained general surgeon. Every artery was operated on by someone who knew how to operate on arteries. Every bone was taken care of by a trained orthopod. I'm sure that had never happened before in history. And frequently all these doctors were operating on one patient simultaneously. There may have been a chest injury, a head injury, a belly injury and a leg injury. The whole team operated in unison. It was quite inspiring.

So being at NSA was like being in a major medical center back in the States?

That's exactly what I saw. We did some off-the-cuff observations on evacuation times. The period we observed between injury and arrival at the hospital was about 20 minutes. We had a whole Henry Ford assembly line right where the chopper landed. We had one corpsman who manned a hose. As the patient was lifted off the chopper, he hosed him down because most of them were injured in the rice paddies and they were covered with buffalo dung and mud. Then their clothes were removed. We put big-bore IVs in them and gave them a lot of saline and also bicarbonate. We got them very rapidly resuscitated before they even got any blood. Then they were triaged.

We learned that resuscitation was based on using salt water rather than dextran, or uncross matched O blood. We used the notion of "filling up the tank," so to speak, with salt water and then replacing red cell deficits with red cells.

Was this normal saline?

Yes, normal saline or Ringer's lactate. Then we carefully cross-matched red cells. These were washed preserved red cells or the frozen cells. If you were giving O to an A, you had fewer complications than you would had you been using whole blood transfusions.

There were some patients whose blood we completely transformed from A to O. Then you can imagine someone trying to figure out what that patient's type was once he arrived in Subic.

And the dogtag said something different.

Exactly. They had mixtures they couldn't cross-match. I flew back to Subic a couple of times to see how these patients were doing. I spent time with the blood bankers there and it was a real problem trying to identify a patient's blood type at that instant.

Was this a permanent blood type change with these patients?

No. Once they began producing their own red cells, then they had mixtures of transfused cells and their own cells. The transfused cells had a half life of a month or something. Eventually the patient would return to their regular blood group. On the other hand, they may

have required another operation and a transfusion in the meantime and that blood would have to be cross-matched.

So for that particular day, you'd have to decide what blood group they were in.

Exactly. And that was, theoretically, another opportunity to use these O negative, Kell negative, Duffy negative red cells. But they didn't have a facility at Subic.

The study progressed and very quickly, the surgeon and anesthesiologist preferred using the frozen red cells when they were available.

Because the red cells were a known quantity?

Yes. Because you knew these were pristine cells--no plasma, no white cells, no antibodies. And the blood grouping was unquestionably correct. This study was carried out between December '65 and July of '66 when I left.

What was the conclusion you and your fellow researchers came to?

It culminated in a paper Bob [Valeri], Chuck [Brodine], and I wrote, which was the lead article in the *New England Journal of Medicine*, which was quite a thrill for all of us.

And that was in '66?

No. The paper came out in '68. It took us time to figure out how to format the data. There was a series of Marines who received large amounts of the frozen red cells. What we looked for were adverse effects or events. The fundamental question was, did the red cells hemolyze during transfusion. Was there evidence of hemolysis? So we measured plasma, hemoglobins, urine hemoglobins, plasma haptoglobins. We did everyone's creatinines, blood gases, pretty much the whole gamut. And we did all this in a war zone.

And I know the hospital was rocketed every once in a while.

Yes it was. And even so, we carried out first-class, stateside, esoteric research right there at the hospital.

Overall, you were highly successful in proving that frozen blood was the way to go in this type of situation.

What we said was this. If you look at the variables, this was a safe procedure. And it eliminated the possibility of an incompatible cross-match, which as you know is a danger when treating mass casualties. And that it provided a secure base of compatible cells, taking into account the ebb and flow of battle and the short half-life of liquid preserved red cells.

So, the frozen blood turned out to be a very reliable source.

Exactly. You might have a thousand units sitting in a freezer. So the question is: How come it wasn't used? The other parts of the story were that there was a finite period required to thaw and wash the cells and prepare them. It required a reliable source of energy to run the agglomeration machines. Was there sufficient advantage to going through this process of thawing, washing, agglomerating, collecting the frozen red cells as opposed to simply opening the door of a cooler and hanging up a unit of blood? The argument had to do with the reliable supply on the one hand--the frozen cells--versus the ease of using liquid preserved cells. But our

job then was to simply show whether it was feasible, safe, and effective to use this system in a war zone. And the answer was yes.

The biggest impediment seems to have been the whole agglomeration process.

Yes. The ideal answer would be to have come up with a cryopreservative which didn't need to be washed out.

But that never happened.

No. It never happened. I stayed in the Navy an extra few years because not only was I interested in the frozen red cells but another thing happened while I was there. We found that a number of patients had developed pulmonary failure. These were patients who had been tremendously injured and had been given huge volumes of resuscitation fluids. They developed pulmonary failure and died from what looked like pulmonary edema. The question was whether this was due to too much saline and not enough colloid, which has an oncotic property that inhibits fluid from seeping into the lung tissue.

This work consumed a good part of my professional life after that. I became more focused on the lung injury and less on the frozen blood after I left Vietnam.

You left Vietnam in '66.

Yes. In the summer of '66. Then I went to NMRI [Naval Medical Research Institute] and was also in charge of the surgical research lab.

When did you leave the Navy?

I left in November of '69.

Where did you go from there?

I came to Illinois and became Chief of Surgery at Cook County Hospital, where I convinced the blood bankers to start a frozen blood bank. By the way. Bob [Valeri] and I were working very closely then. I was working with the blood bank folks to convert the blood bank into a completely frozen system. There were logistic and expense issues and so it was not a permanent enterprise.

For me the lifelong interest occurred shortly after I left the Navy. I received a call from a colonel named Larry Rose who was at the R and D command with the Army. He told me that the Army had an interest in artificial blood products. The investigator they were working with came to a parting of the ways and they wanted to know if I'd be interested in taking on that project. It involved harvesting hemoglobin from red cells and modifying them in such a way that they could be used by the cells as an oxygen carrier. That was about 1970 and I've been doing it ever since.

In '85 the military support for my lab ended when they switched to the pharmaceutical industry. My colleagues and I formed a company called Northfield Labs. For me, that was based on my observation back in Vietnam that the percentage of units that were in country became outdated very quickly, so it was a hugely inefficient system. Collecting all the various blood groups was a logistic problem. There were times when you had a lot of blood but it was inappropriate for that particular patient.

At some point you became dean of the medical school. How did that happen?

By the late ’70s, I moved from being head of surgery with Cook County to head of surgery at Michael Reese Hospital in Chicago, and professor at the University of Chicago. This is when most of the work on the hemoglobin solution was being carried out. I think we were the leaders in the field.

In 1989 the University of Illinois medical school invited me to apply for the dean’s job, which I did. I was dean from ‘89 until a month ago when I retired.

But you’re still doing the blood work.

Now I’m a paid consultant to Northfield. Phase III trials are now underway comparing hemoglobin-based oxygen carriers to packed red cells.

It’s been 35 years since you served in Vietnam. Do you think much about that time anymore?

I do. I think about it all the time. I have a little talk I put together for the students which is titled “Vietnam Recalled.” I take them through the context and the time--the Berry Plan and the pivotal phone call I got from Charlie Huggins asking me if I was interested in an adventure. And that’s exactly what it was. The result was that it affected the rest of my professional life and I’m still interested now almost 40 years later in precisely what I was interested in during my time in Vietnam taking care of Marines. You never know where life is going to take you.

I’ll bet you’re glad you didn’t end up on the *Saratoga*.

Absolutely. I certainly wouldn’t want to be a war zone but I’m very grateful that I had the opportunity to be there.